5

Chapter 5 - General Environmental Considerations for the Transmission Line Projects

This chapter provides some general background information about the PSCW's environmental analyses of electric transmission line projects. The information in this chapter can be used to help understand more about the specific environmental and socio-economic effects that would occur along various portions of the proposed project and for different system alternatives. The first part explains the major issues that the Commission staff considers in its analyses of transmission line proposals. The second section describes impacts related to particular subject areas, such as agriculture, property values, and wetlands. Possible mitigation measures for specific impacts are discussed in general here and in greater detail in the chapters on the project sectors.

Issues Related to Environmental Impact Assessment

Some questions that need to be asked when conducting an environmental assessment of a proposed project include: What is the area affected? What is the quality of the existing environment? What types of impacts are expected? What is the degree of impact expected? What measures can be used to minimize these impacts?

The area affected by a new transmission line depends on the topography, the type of land cover, and existing land use. In forested areas, for example, the entire ROW width would be cleared and maintained free of tall-growing vegetation in perpetuity. This would result in a permanent change in land cover for the entire ROW width. In agricultural areas, the entire ROW width may be used for moving equipment and vehicles during construction of the line, but because cropping and pasturing can still occur beneath the line following construction, the area permanently affected by the line may be much smaller. When transmission lines are routed through areas that are valued for their scenic qualities, the visual impacts of a line may extend well beyond the actual ROW.

In considering the quality of the existing environment several factors are important:

- The degree of prior disturbance.

  Has the area been logged, drained, developed, cultivated, or otherwise substantially altered from its pre-settlement condition? To what extent?

- The uniqueness of the resources.

  Is this a species or community type that is uncommon in the region or in the state? Does the resource possess a feature that makes it unique, such as its size or species diversity? Does the resource play a special role in the surrounding landscape?

- The threat of future disturbance.

  Will surrounding land uses affect the quality of the resource over time? Is the resource valued by those who own or manage it?

  When describing the types of impacts expected, it is important to consider both long-term and short-term impacts, as well as those caused by construction and those that will reoccur or continue after the construction phase. Long-term impacts exist as long as the line is in place. An example of a long-term impact is the potential for bird/wire collisions when power lines are routed across wetlands that are heavily used during migration periods. Temporary impacts may occur only during construction or at infrequent intervals during line repair or ROW maintenance. An example of a short-term impact is crop damage from construction equipment. Mitigation of potential long-term impacts is especially important.

Environmental features, such as soil type, topography, and land cover, can also affect the degree of impact. For example, heavy clay soils may be more greatly affected than sandy soils if construction occurs when the substrate is wet. Some physical features that affect the degree of impact include the line design, the amount of ROW needed, and pole placement. While undergrounding a line through a scenic area would still require a cleared ROW, it would eliminate the aesthetic impacts associated with the visual intrusion of the line and structures.

When the effects of new power lines cannot be avoided, adjustments can often be made to lessen the severity of the impacts. Mitigation of environmental and socioeconomic impacts can be incorporated into the design process, the construction process, and in long-term ROW maintenance procedures. Some examples of these various mitigation techniques are outlined in Tables 5-1 to 5-3.

Table 5-1 Mitigation strategies during siting and design

Design Feature	Mitigation Opportunity
Route	Corridor-share to minimize ROW needed; cross a road to avoid removal of mature trees on residential properties.
Structure type	Use H-frame to enable a longer span across a river or wetland; use oxidized steel to blend in with forested background; use low-profile structures to avoid interfering with flight approaches to airports and airstrips.
Pole placement	Shift pole locations slightly to avoid archeological sites; locate on or at edge of road ROW to minimize effects on agricultural operations.
Add-ons	Add flight diverters to conductors to minimize bird/wire collisions; use vibration dampeners to minimize line noise.

Table 5-2 Mitigation strategies during construction

Construction Technique	Mitigation Opportunity
Timing	Construct in wetlands when vegetation is dormant and the ground is frozen; delay construction in cropped areas until after harvest.
Proper equipment	Use wide-track vehicles and matting in wetlands to avoid soil compaction and rutting.
Erosion control	Apply erosion control methods approved by DNR and revegetate disturbed areas with appropriate native species immediately after construction.

Table 5-3 Mitigation strategies post-construction

ROW Maintenance	Mitigation Opportunities
Invasive species management	Clean equipment to avoid introduction of non-natives (e.g. purple loosestrife) and survey ROW following construction to eliminate new populations caused by construction disturbance.
Habitat management plans	Work with resource agencies/local organizations to develop maintenance schedule and techniques to enhance habitat for rare or desirable species or communities (e.g. conduct prescribed burns to encourage native prairie).
Restoration	Chisel plow compacted soils in agricultural areas to restore soil structure; replant ROW following tree removal with lower-growing woody vegetation to maintain forest character.
Trimming techniques	Feather ROW edges in forested areas to minimize aesthetic impacts and maintain wooded habitat; leave vegetation and branches overhanging streams to maintain water quality and temperature.

One of the most useful methods in reducing the level of environmental and socioeconomic impact of a new transmission line is corridor sharing, that is, sharing all or part of the ROW with an existing facility. Other facilities can include major or minor roads, gas or oil pipelines, railroad corridors, or other electric transmission lines. Placement adjacent to an existing facility without overlapping ROWs can also be considered corridor sharing in some situations.

In general, sharing corridors with existing facilities minimizes impacts by:

- Reducing the amount of new ROW needed.
- Concentrating linear land uses and reducing the number of new corridors.
- Creating an incremental, rather than new, impact.

However, in some situations, corridor sharing can also have drawbacks. Some examples of these disadvantages are described in Table 5-4.

Table 5-4 Possible disadvantages of some corridor sharing opportunities

Corridor Shared	Potential Drawback
Railroad	Access roads may be needed if the railroad goes for long distances without crossing roads.
Gas pipeline	Pipeline ROWs often run cross-country and, if properly installed, may have little or no visual or agricultural effects. Power lines running cross-country in open areas can interfere with farm operations and often have a strong visual impact.
Town and country roads	In some areas, branches and leaves of large trees form a canopy over the road. Clearing these trees changes the aesthetic character of local roads.
Existing power lines	Parallel power lines in farmland can create greater impact than two separately placed lines due to problems cultivating around structures. Stacked (double circuit) lines may create a hazard if located in a flyway or other area heavily used by birds.

Most corridor-sharing requires some accommodation with the existing facilities. For example, communication circuits for railroads may need to be placed underground. Sharing a corridor with a gas pipeline may require the installation of a cathodic system to prevent pipeline corrosion caused by induced currents. Power line poles located on highway ROW must be moved at the ratepayers' expense if the highway is expanded. Putting a new transmission line on an existing power line ROW might involve taking down the existing structures and replacing them with larger poles.

One additional drawback to corridor sharing is that landowners who have agreed to an easement for one facility sometimes feel unfairly burdened by the addition of another facility that further limits their rights and use of their property

While the presence of one or more utility corridors may limit landowners' use of their property, they are guaranteed specific rights with respect to the physical condition of their property during and following construction of a new transmission line. The following section describes these rights and explains how they relate to an easement contract negotiated between a landowner and a utility.

Landowners' rights and waiving those rights

Wisconsin law lists some rights of landowners whose properties are affected by a transmission line that is 100 kV or larger and over one mile in length. These rights are listed below. When

negotiating an easement contract, a landowner may agree to waive or give up, one or more of these rights but does not have to do so. In a contract, marked or crossed-out items would be "waived" or no longer applicable if the landowner signs the contract.

Landowners who have signed an easement agreement with a utility have a specific rights listed in the Wisconsin Statutes. These rights are applicable for high voltage power lines (100 kV or larger, and longer than one mile) built after 1976.

Under Wisconsin law, Wis. Stat. § 182.017(7)(c) to (h), the rights are expressed as utility requirements:

> (c) In constructing and maintaining high-voltage transmission lines on the property covered by the easement the utility shall:
>
> 1. If excavation is necessary, ensure that the top soil is stripped, piled and replaced upon completion of the operation.
>
> 2. Restore to its original condition any slope, terrace, or waterway which is disturbed by the construction or maintenance.
>
> 3. Insofar as is practicable and when the landowner requests, schedule any construction work in an area used for agricultural production at times when the ground is frozen in order to prevent or reduce soil compaction.
>
> 4. Clear all debris and remove all stones and rocks resulting from construction activity upon completion of construction.
>
> 5. Satisfactorily repair to its original condition any fence damaged as a result of construction or maintenance operations. If cutting fence is necessary, a temporary gate shall be installed. Any such gate shall be left in place at the landowner's request.
>
> 6. Repair any drainage tile line within the easement damaged by such construction or maintenance.
>
> 7. Pay for any crop damage caused by such construction or maintenance.
>
> 8. Supply and install any necessary grounding of a landowner's fences, machinery or buildings.
>
> (d) The utility shall control weeds and brush around the transmission line facilities. No herbicidal chemicals may be used for weed and brush control without the express written consent of the

landowner. If weed and brush control is undertaken by the landowner under an agreement with the utility, the landowner shall receive from the utility a reasonable amount for such services.

(e) The landowner shall be afforded a reasonable time prior to commencement of construction to harvest any trees located within the easement boundaries, and if the landowner fails to do so, the landowner shall nevertheless retain title to all trees cut by the utility.

(f) The landowner shall not be responsible for any injury to persons or property caused by the design, construction or upkeep of the high-voltage transmission lines or towers.

(g) The utility shall employ all reasonable measures to ensure that the landowner's television and radio reception is not adversely affected by the high-voltage transmission lines.

(h) The utility may not use any lands beyond the boundaries of the easement for any purpose, including ingress to and egress from the right-of way, without the written consent of the landowner.

As contracts, easements should be written in legally precise language. The landowner's rights as listed above are generally included as part of the contract by being attached as an "Exhibit." A term of the contract will state that those rights that are marked or crossed out would be "waived," i.e., not included in the contract. The waiver of these rights, as well as any other part of the contract not required by law, is negotiable.

General Impacts Associated with Transmission Lines

The following pages describe many of the environmental and human impacts related to the construction and operation of transmission lines in general. Because many of these impacts are applicable to each of the routes for the proposed Arrowhead-Weston 345 kV line and the Tripoli-Rhinelander 115 kV line, this section is referenced frequently in Chapters 7-9 and Chapter 11. It should help to provide background information for the route-specific impacts described in those chapters.

Aesthetic effects

The overall aesthetic effects of a high-voltage transmission line are likely to be negative to most people, especially for a line that traverses a relatively undeveloped landscape. Many people consider natural resources and power lines to be incompatible. Joint studies by the University of Wisconsin and the U.S. Forest Service found that regardless of gender, socioeconomic class, or education, our "peak aesthetic experiences" occur more often in natural setting than in human-

constructed settings. Corridor sharing with existing infrastructure or routing the line through developed landscapes, such as farmland or business parks, could alleviate some of a line's aesthetic concerns for people with this perspective.

In addition to perceptions about how power lines fit into natural environments, some may find the "scale" of a high-voltage transmission line inappropriate in some settings. Tall steel structures used for double circuit construction and massive steel lattice corner structures may appear out of proportion with adjacent buildings, fence rows, and forests and therefore, seem unsuitable in a particular landscape. Lines constructed using H-frame poles or on wood rather than steel structures may, in some cases, blend in better with their surroundings.

Other people may find a transmission line objectionable from an aesthetic perspective because of what the line represents to them - in reality or in their expectations. The line may represent a loss of personal enjoyment and satisfaction in the appearance and use of their property, fear about their personal safety, or a monetary loss due to property devaluation or foreclosure of future sales or development opportunities. It is unlikely that mitigation measures short of rerouting the line, such as modifying the pole design or span length, could overcome the negative perceptions of people in this group.

Finally, research and anecdotal information indicates that there are some people who, for the most part, do not notice transmission lines or do not find them objectionable from an aesthetic perspective. The lines, like roads or water towers, may be viewed as part of the infrastructure necessary to sustain our everyday lives and activities. To others, new transmission lines may be viewed in a positive light in that they represent economic development.

In the end, aesthetics, including what appeals to our aesthetic nature and what affronts it, are to a great extent based on individual perceptions. Certain measures can be implemented in the siting, design, and construction of the line or the maintenance of the ROW to mitigate some of the adverse aesthetic effects of a line. It is in the interest of the applicants and the affected landowners to discuss and consider these measures early in the planning and design process.

Impacts on agricultural lands

The construction and maintenance of high-voltage transmission lines across or adjacent to agricultural fields can affect farm operations in numerous ways. Many of these impacts, if not mitigated or compensated, could increase farming costs. The Agricultural Impact Program at the DATCP prepares an AIS to aid farmers in determining just compensation for their losses. State law requires utilities to repair much of the damage that can occur and provide monetary compensation for damages that cannot be easily repaired. Easement agreements should include a discussion of expected damages and mutually agreed-upon reparation.

Depending on the placement of individual poles, routing a transmission line in an agricultural setting can:

- Create problems for turning field machinery and maintaining efficient fieldwork patterns.
- Create opportunities for weed encroachment.
- Compact soils and damage drain tiles.
- Result in safety hazards and damaged machinery if collisions between equipment and poles or guy wires occur.
- Hinder or prevent aerial spraying or seeding activities by planes or helicopters.
- Interfere with well drilling or well maintenance (where wells are very close to the line).
- Reduce opportunities for consolidation of adjacent farm fields.
- Foreclose or limit future opportunities for subdividing the area for residential development.

Placement of power line corridors along field edges or between fields where windbreaks have been planted can also cause impacts if removal of the windbreaks is required. The windbreaks reduce soil erosion caused by strong winds and also keep snow, which eventually melts and recharges the groundwater, from blowing off the fields. Removal of windbreaks can be mitigated by trimming selectively, replanting lower growing trees and bushes beneath the line, or by creating a new windbreak elsewhere, such as along a different field edge.

Problems with pole placement can be mitigated to some extent by:

- Using single pole structures.
- Placing the line along fence lines or adjacent to roads, in road ROW.
- Using larger poles with longer spans to clear fields.
- Orienting the structures with the plowing pattern to make farm equipment less difficult to use.
- Keeping guy wires out of crop and hay lands and placing highly visible shield guards on the guy wires.
- Minimizing pole heights in areas where aerial spraying and seeding are common.
- Installing markers on the shield wires above the conductors.
- Locating new transmission lines along existing transmission or distribution line corridors.
- Working with farmers to determine optimal pole locations.

Problems with potential soil erosion and compaction can be lessened by:

- Requiring the applicants to chisel plow following construction if soil damage has occurred.
- Avoiding construction and maintenance activities during times when the soil is saturated.
- Avoiding the removal of critical windbreaks and replanting windbreaks with lower growing woody species.

The issue of stray voltage is also a major concern for some farm operators. Although stray voltage is more often associated with distribution service than high-voltage transmission lines, additional background information on this topic is provided in a later section of this chapter.

Conservation reserve program lands

There are farmlands in Wisconsin managed under the Conservation Reserve Program (CRP), a federal program established to protect cropped lands that are vulnerable to erosion. The CRP, a voluntary program created in 1985, provides participants with an annual per-acre rent plus half the cost of establishing a permanent land cover (usually grass or trees). In exchange, the participant retires highly erodible or environmentally sensitive cropland from production for 10 to 15 years.

The CRP's primary goal was extended and broadened in 1990 and again in 1996 to encourage enrollment of filter strips and riparian buffers next to water bodies for the purpose of protecting water quality and promoting wildlife habitat. Presently, acreage enrolled in the CRP includes:

- Land converted from crops to wildlife habitat or special shallow water areas.
- Filter strips along surface waters.
- Grass cover for erosion control.

Federal funding for the program has become more limited; the United States Department of Agriculture (USDA) has the funds to protect an estimated 15 percent of the actual eligible cropland. Only those parcels that can achieve the highest environmental benefits relative to the cost of the new 10-15 year contracts are now eligible for the program. Selection is based on an "environmental benefits index" composed of five factors. One factor is cost. The NRCS in the USDA uses the following four factors to judge the potential environmental contributions of each parcel offered:

- Groundwater and surface water quality protection.
- Wildlife habitat creation.
- Soil erodibility control.
- Tree planting.

Based on these criteria, any CRP lands along a transmission route may include lands that are extremely vulnerable and would not respond well to construction impacts or lands that provide environmental values. While the law may not prohibit installation of a transmission line across CRP lands, the NRCS and local Land Conservation Department (LCD) would determine if a transmission line is compatible with a particular CRP parcel.

Impacts on airports and airstrips

Transmission lines are a potential hazard to aircraft during takeoff and landing. To ensure safety, local ordinances and Federal Aviation Administration (FAA) guidelines limit the height of objects off the ends and sides of a runway. To meet safety standards, the applicants can route power lines outside the safety zone, use special low-profile structures, put a portion of the line underground, or place lights or other attention-getting devices on the conductors.

Archeological and historical sites

Archeological and historical sites and artifacts are important tools for learning about ourselves and our ancestors, our origins, and how we have adapted to our environment over time. They may also have religious value, such as Native American burial mounds.

Archeological artifacts are most valuable if found in place. Their location helps to date them and understand their use. The spatial relationship of objects to each other helps archeologists learn about the economy and the type of society that existed when the objects were made and used.

Construction and maintenance of a transmission line can damage sites through excavation, crushing by heavy equipment, uprooting of trees, wind or water erosion, and exposing sites to vandals. Potential impacts can occur whenever soil will be disturbed. This includes actual pole placement, leveling ground surfaces, and preparing the pad and driveway area for substations.

Findings of archeological resources do not always mean that route changes are necessary. Small changes in pole locations and span length can often avoid sites and artifacts.

SHSW has the primary responsibility of protecting archeological resources. Because the Commission authorizes power line and power plant projects, it often must act as the SHSW's agent to ensure that damage to known archeological sites is avoided or reduced.

If the project requires any federal permits, the federal agency involved must also act as the SHSW's agent. Federal requirements supersede the Commission's obligations in these cases. Both the Commission and the federal agencies require the applicants to identify known archeological sites along proposed routes by searching SHSW records. If identified sites are present in the area, the SHSW may require a field survey to pinpoint the exact locations of these resources. The SHSW has no direct authority over the applicants, so the PSCW or the applicable federal agency would order the survey to be done. If sites or artifacts are found at the

same location as a proposed substation or power pole, the applicants must follow SHSW recommendations to minimize impacts on those sites.

Within the project area, the SHSW might also identify areas that have a high likelihood of harboring undiscovered archeological resources. Agreements about what the applicants would do to preserve these resources, if found, are made on a project-by-project basis.

Cultural concerns

A cultural concern can occur when an identifiable group or community has practices or values that may conflict with a new transmission line. An example of a cultural concern that has been addressed in the past is the analysis of proposed transmission line routes through an Amish community. Because the Amish do not use electric service, attempt to remain non-confrontational, and tend not to become involved in government processes, a concerted effort was made avoid the impacts on this community. Cultural impacts may also be related to general social concerns, such as fairness, that are discussed later in this chapter.

Endangered and threatened species

Endangered species are any species whose continued existence is in jeopardy. Threatened species are species that appear likely, within the foreseeable future, to become endangered. Special concern species are those species about which some problem in abundance or distribution is suspected, but not yet proven.

The BER of the DNR uses the NHI as the foundation for its preservation efforts. The inventory is based on current and historical surveys of rare plants, animals and natural communities. Up-to-date maps and computer databases provide information on the location and status of these resources to the applicants and PSCW staff.

Construction and maintenance may directly harm individual plant or animals or alter their habitat so as to make it unusable or unsuitable. Potential impacts include:

- Destroying individual plants or animals by crushing or digging with heavy equipment.
- Degrading water quality through soil erosion and siltation into rivers and wetlands that provide habitat for rare plants or animals.
- Clearing trees used as perching or nesting sites by rare birds.
- Degrading woodland or wetland quality through removal of trees and brush, making the area unsuitable for rare plants or animals.

In some cases, power line ROWs have been managed to provide or improve habitat for some threatened or endangered species or rare communities. Close cooperation between the applicants, ROW maintenance staff, and the BER is necessary in designing and implementing

the management plans. Several projects of this type have been successfully undertaken by Wisconsin utilities.

Impacts to rare species can be avoided or minimized through several means. Projects that may harm rare species and unique natural resources can often be redesigned or relocated to minimize or eliminate potential impacts during the planning phase. When rare plants or animals are known to be present in a project area, BER may recommend surveying an area to pinpoint the exact locations of the species. The PSCW has the authority to order the applicants to conduct a survey and implement mitigation measures when necessary. These measures may include modifying the route or line design, special construction techniques, or restricting the time of construction to avoid or minimize potential impacts.

Forest resources

Many Wisconsin forests serve multiple uses. With sustainable forest management, these forests can provide recreational opportunities, wildlife habitat, habitat for rare plants and animals, timber, pulp and ecosystem preservation. Building a major high-voltage power line through northwestern Wisconsin, which is primarily forested, would require clearing many acres of trees and shrubs. Depending on where a line is placed, this clearing could cause public and private forest devaluation, forest fragmentation, general loss and degradation of wooded habitat, and pulp and timber losses.

Clearing for agricultural, urban, and residential development has resulted in the disappearance of much of the original forest land of Wisconsin. Relatively few large tracts of undisturbed forest land remain in southern Wisconsin. Much of the remaining sizeable tracts of forestland in the state are now found north of USH 29, in counties affected by the proposed project. (See Figure Vol. 2-18 Wisconsin Land Cover Map.)

A discussion of forest values, forest management practices, and potential forest impacts follows.

Forest valuation

Economic valuation techniques have been used to measure consumer demand for environmental quality. Survey studies in the western U.S. and abroad illustrated that it is possible to measure the public's willingness to pay for forest quality protection programs. [130] [131] In general, the surveys found a theoretical price that people would willingly pay either as a direct cost of recreating or as a tax that is complementary to other forms of environmental protection. The benefits of preservation as viewed by the public were separated into option, existence and

[130] Lockwood, M., J. Loomis, and T. DeLAcy. 1993. A Contingent Valuation Survey and Benefit-Cost Analysis of Forest Preservation in East Gippsland, Australia. J. Env. Qual. 38, 233-243.

[131] Walsh, R.G., R.D. Bjonback, R.A. Aiken, and D.H. Rosenthal. 1990. Estimating the Public Benefits of Protecting Forest Quality. J. Env. Mngmt. 30, 175-189.

bequest values: (1) option value is defined as willingness to pay for the satisfaction of knowing there is the possibility of personal recreational use in the future; (2) existence value is the willingness to pay for the satisfaction of knowing that forest quality is protected even though no recreation use is contemplated; and (3) bequest value is defined as the willingness to pay for the personal satisfaction of endowing future generations with forest quality.[132] Research indicates that forest managers must consider public concerns for forest values other than traditional economic benefits.

Conversely, landowners are at liberty to maximize their economic objectives on privately held forest lands. Different management goals among private ownership groups can prove problematic for forest ecosystem preservation. While the economic objective is dominant on industry lands, the non-industrial owner may value recreation and aesthetics over timber production, even though he (or she) is often at the mercy of economic forces. Therefore, non-industrial forest owners will manage their lands in a more complex and less predictable way than the forest industry.[133] Private landowners and public land managers are acknowledging however, that a balance between economic and ecological goals is essential to overall forest ecosystem viability.[134]

Economists and foresters have calculated non-timber values for forests that can possibly factor into harvesting plans and foster more consistent land management among different land management groups. Standing timber is an amenity that can be virtually banked and is in fact more valuable than the timber maximizing harvest. In terms of a landowner's bottom line, unless a tree species needs to be harvested by clear-cut in order to regenerate, it would be more cost-effective to selectively harvest merchantable timber and leave the majority of the stand behind for natural regeneration. The two-fold benefit of this management strategy is attainment of economic objectives and harvest management continuity among the different owner groups.

A study in an eastern hardwood forest indicated that it would take approximately 100 years following heavy cutting before a northern hardwood forest can recover to old-growth status.[135] Harvesting practices that leave a diversity of both tree species and age classes also leave a forest available to multiple uses, such as old-growth research and wildlife management. Since trees in a

---

[132] Walsh et al. 1990.

[133] Dennis, D.F. 1989. An Economic Analysis of Harvest Behavior: Integrating Forest and Ownership Characteristics. For. Sci. 35, 1088-1104.

[134] Lin, C., and J. Buongiorno, 1998. Tree Diversity, Landscape Diversity, and Economics of Maple-Birch Forests: Implications of Markovian Models. Mngmt. Sci. 44, No. 10, 1351-1366.

[135] Martin, C.W., and A.S. Bailey. 1999. Twenty Years of Change in a Northern Hardwood Forest. For. Ecol. and Mngmt. 123, 253-260.

forest provide food, shelter, and substrate for other life forms, maintaining a rich variety of both tree species and canopy structure helps to conserve biodiversity in a forest ecosystem.[136]

Sustainable forestry

Traditionally, forestry defined sustainability as a cutting regime in which a target volume of timber could be maintained indefinitely, that is, sustained yield.[137] This definition is due in part to how land managers found the condition of the northern hardwood forest following intensive logging and recurrent fire that occurred throughout northwestern Wisconsin in the late 1800s and early 1900s.[138] The job of forest managers became one of assessing potential productivity and then manipulating forest stands to bring productivity up to this theoretical potential.

The sustainable forestry paradigm has begun to shift away from focusing on trees, or stand level management, to focusing on forest ecosystems and creating and maintaining dynamic landscapes. Sustainability has been broadened to include the maintenance of structural and species diversity as well as the cycling of nutrients between trees and soil that supports fiber production and the food web.[139] Biodiversity maintenance and prevention of environmental degradation are now seen as essential to overall sustainability. The need for heterogeneous landscapes requires forest management objectives to consider forests on a larger spatial scale.

Forest management

The northern hardwood forest of northwestern Wisconsin is a landscape of extreme contrasts in forest ecosystem properties. These ecosystem properties stem from four major influences: (1) the strong effects of different tree species on resources that control forest growth and productivity, particularly light and nutrients; (2) the varied scales and types of disturbances; (3) the strong control on species composition exerted by browsing mammals and insects; and (4) a variety of reproductive strategies.[140] Managing this forest type for sustainable yield involves a variety of silvicultural practices that include leaving stands free of human disturbance, clear-cutting and selective cutting. Practices that create fluid boundaries between forest types promote a diversity of tree species and age classes and foster a more heterogeneous forest that

---

[136] Lin and Buongiorno 1998.

[137] Pastor, J., and D. Mladenoff. Pp. 16-29 In: Modeling Sustainable Forest Ecosystems. Proceedings of a Conference in Washington, D.C. November 18-20, 1992. American Forest, Washington, D.C.

[138] Crow, T.R., G.E. Host, and D.J. Mladenoff. 1999. Ownership and Ecosystem as Sources of Spatial Heterogeneity in a Forested Landscape, Wisconsin, USA. Landscape Ecol. 14, 449-463.

[139] Pastor and Mladenoff 1992.

[140] Mladenoff and Pastor 1993.

allows the overall ecosystem to adapt to different disturbances such as climate change and insect infestation.

Typical tree species found in the northern hardwood forest include maple, birch, ash, aspen, oak, jack pine and red pine. These species need different management styles to regenerate and produce healthy stands of merchantable trees. Maple and aspen are among the more merchantable species in the northern hardwood forest and are at opposite ends of the management spectrum. Maple is considered shade-tolerant and can be regenerated and managed through the use of low impact harvesting techniques such as thinning or selective cutting. Because of their shade tolerance, a stand can be selectively harvested to leave behind a combination of sapling to mature tree classes. The mature trees provide the seed source for regeneration and periodic thinning of the canopy releases younger trees that have been growing in the shade.[141] Conversely, aspen is a shade-intolerant species that is best managed using the clear-cut method. Aspen can regenerate from its own seeds under ideal conditions, but typically regenerates from root sprouts or "suckers" after trees have been cut.[142] Thus, a singular approach to forest management is not suitable.

The mosaic pattern of private and public land ownership in northwestern Wisconsin causes inevitable clashes of forest management practices. State forests, private industrial forests and private non-industrial forests may all have different management styles and needs. Public land managers, as part of their mandate, must manage the forest in a way that considers the public opinion and provides for sustainable forestry. As an example, the Washburn County Ten Year Comprehensive Management Plan (1996-2005) defines sustainable forestry as practices that foster land stewardship ethics that both nurture productive trees and conserve finite resources such as soil, water and wildlife habitat. Managing a forest under this paradigm places an emphasis on what is left in a stand rather than what is removed and is an excellent example to private landowners that economic objectives can prevail through conservative harvesting. In addition, the Washburn County Plan establishes a policy for old-growth areas to be preserved as integral components of landscape diversity as well as teaching tools.

Private non-industrial forest landowners can choose to manage forest land in a variety of ways. Landowners can enroll forest land into state sponsored tax shelter programs such as the Managed Forest Law Program in Wisconsin. In order to participate, forest owners must contractually agree, with the state of Wisconsin to a management plan that includes harvesting on at least 80 percent of their land. Creating an individualized forest management plan allows a landowner to incorporate some personal values into the methods and timing of the required timber harvesting. Private woodlands enrolled in Wisconsin forest tax law programs, such as the Forest Crop Law or Managed Forest Law programs, could be affected on a long-term basis by

---

[141] Lorimer, C.G. and C.T. Locey. Lake States Woodlands: Managing Northern Hardwoods. University of Wisconsin-Extension, University of Wisconsin Board of Regents. 1996.

[142] Wooden, A.L., C. Locey, and G. Cunningham. Lake States Woodlands: Aspen Management. University of Wisconsin-Extension, University of Wisconsin System Board of Regents. 1996.

construction of a power line through their property. (See the "Effects on land in managed forests programs" discussion below.)

Private industrial forests are managed primarily for forest products but many ecosystem benefits are also garnered from these forests. In the northern hardwood forests, industrial harvesting practices are similar to those used on both public and private non-industrial forest lands. Hardwoods such as maple, birch and oak are managed through uneven-aged selective cutting, conifers are managed through thinning or even-aged management depending on species, and aspen are managed using even-aged management in 50-55 year rotations. In addition to providing continuity on the landscape, the majority of industrial forest lands in the northwestern part of Wisconsin is enrolled in state forest programs such as the Managed Forest Law or the Forest Crop Law. These programs provide tax benefits to the industry while mandating that their harvest prescriptions are consistent with state initiatives and that the lands enrolled in the program are open to public access for hunting, fishing and general recreation such as hiking. These forests also provide bountiful wildlife habitat and represent a dynamic landscape that enhances both ecosystem health and enriches biodiversity across the region.

Forest fragmentation and neotropical migrants

Forest fragmentation is a complex ecological phenomenon that occurs when landscapes with large unbroken areas of natural forest are gradually converted to agricultural, urban, and commercial uses. Ecologists recognize forest fragmentation as a serious environmental problem. This gradual conversion to other uses fragments or cuts large unbroken forests into increasingly smaller pieces. Development of cleared corridors for infrastructure such as highways, pipelines and power lines can cause forest fragmentation. Eventually, if fragmentation is allowed to continue, a forest will suffer a permanent reduction in its vegetative and wildlife diversity and loose its ability to function as an ecological unit. An example of how forest fragmentation can affect the ecological function of a forest can be found in the response of certain birds, known as neotropical migrants.[143] Data from the USFWS Breeding Bird Survey conducted from 1966 through 1991 indicate that in North America, the population of neotropical migrants has decreased significantly. For some species, such as the ovenbird and Acadian flycatcher, populations have decreased by over 65 percent.[144] Wisconsin provides important nesting habitat for about 133 neotropical migrant species. Of these, 59 are found in forest habitats.[145] Several studies have shown the number of neotropical migrants nesting in

[143] Neotropical migrants are birds that breed in the Nearctic (the United States, Canada, and Northern Mexico) and winter in the Neotropics (Central and South America)

[144] Herkert, James R. , R. E. Scafoni, V. M. Kleen, and J. E. Schwegman. 1993. Habitat Establishment, Enhancement and Management for Forest and Grassland Birds in Illinois. Division of Natural Heritage, Illinois Department of Conservation, Natural Heritage Technical Publication #1. Springfield Illinois. Northern Prairie Wildlife Research Center Home Page. http:/www.npwrc.usgs.gov/resource/othrdata/manbook/manbook.htm (version 16Jul97).

[145] White, R. P. 1990. Where Do Wisconsin's Neotropical Migrants Spend the Winter? The Passenger Pigeon. 52(2):127-137.

Wisconsin forests has significantly decreased over time.[146] [147] This decrease has occurred in spite of a general overall increase in forest cover over the last 70 or 80 years. An important factor contributing to this overall population decline is the steady decrease, due to fragmentation, in the individual size of forest blocks and the resultant increase in forest edge. The increase in forest edge has been correlated with increases in nest predators such as blue jays, raccoons, and skunks. Increased edge has also been shown to lead to increased nest parasitism from brown-headed cowbirds. Nest predation and parasitism can lead to significant decreases in the reproductive success of forest interior species. Neotropical migrants are part of a naturally diverse ecosystem and their presence or absence has a direct effect on forest health. During the breeding, nesting, and brood rearing season these birds consume large quantities of insects. Many of these insects are pests that, in large numbers, can negatively affect the viability and health of forests.

Modern forest management practices can be used to manage for songbird species. The magnitude and scale of change in vegetation structure brought about by timber harvest typically determines the degree of change in the bird community.[148] Partial or selective harvesting can mimic natural disturbances within a forest, whereas whole stand tree removal changes tree species composition and creates forest edge. Differential management practices in adjacent forest stands can fragment forest habitat, leading to isolation of suitable habitat patches.

Neotropical migrant songbirds have a variety of habitat preferences, with some thriving in early-successional environments and others preferring later-successional forest environments. Research shows that the challenge for land managers is to determine how to construct dynamic landscapes that balance the age class distribution of the forest and maintain mature forest species.[149] On a biodiversity scale, the implications of forest habitat fragmentation can threaten species dispersal and gene flow. Conservation biologists consider fragmentation of habitat a major threat to biodiversity, although some research shows that intensive forest harvesting practices are compatible with the goal of maintaining viable neotropical migrant birds. A study

---

[146] Ambuel, B., and S. A. Temple. 1982. Songbird Populations in Southern Wisconsin Forests: 1954 and 1979. J. Field Ornithology 53:149-158.

[147] Temple, S. A., and J. Carey. 1988. Modeling Dynamics of Habitat-Interior Bird Populations in Fragmented Landscapes. Consrv. Biol. 2(4):340-346.

[148] Annand, E.M. and F.R. Thompson. 1997. Forest Bird Response to Regeneration Practices in Central Hardwood Forests. J. Wild. Mngmt. 61(1):159-171.

[149] Hagan, J.M., P.S. McKinley, A.L. Meehan, and S.L. Grove. 1997. Diversity and Abundance of Landbirds in a Northeastern Industrial Forest. J. Wild. Mngmt. 61(3):718-735.

in a Missouri hardwood forest further illustrated that the use of both even-aged and uneven-aged practices and selection methods could provide habitat for most forest songbirds.[150]

The negative effects of forest fragmentation are varied, cumulative, and in many cases obvious only to the trained eye. There is no simple rule of thumb that can be used to determine the optimal size for a healthy and fully functional forest. This is because the nature and extent of impacts depend not only on the size of the remaining forest habitat, but also on the nature of the surrounding landscape, and the plant and animal populations being considered. Certain species, known as "area sensitive" species, require contiguous forest habitat to meet their life requirements. The minimum size for sustaining populations, however, depends on the species being considered. For example, in Wisconsin, the pileated woodpecker will not breed in woodlands smaller than 250 acres (100 hectares).[151] The cerulean warbler has been shown to avoid forest blocks smaller than 340 acres (138 hectares) while the worm-eating warbler can utilize forest blocks as small as 52 acres (21 hectares).[152] Mammals, amphibians, insects and plants all have different habitat requirements and respond differently to changes in forest block size.

The nature of the surrounding landscape is also important. In general, the negative impacts of edge effects and competition are greater in agricultural landscapes (see discussion on edge effects below) than in forested landscapes. Studies have shown, for example, that the rate of nest parasitism on wood thrush nests is greater in predominantly agricultural landscapes than in heavily forested landscapes.[153] In another study that compared four landscapes in Ontario, Illinois, and Missouri, researchers found that the rate of increase in the number of forest interior species is greater in forested landscapes than in landscapes where the predominant land use is agriculture.[154]

Because of the complex interaction of species' habitat requirements and the influence of surrounding landscapes, forest fragmentation can affect a wide range of forest block sizes. (In

---

[150] Annan and Thompson 1997.

[151] Ambuel, B. and S. A. Temple. 1983. Area-Dependent Changes in the Bird Communities and Vegetation of Southern Wisconsin Forests. Ecology 64:1057-1068.

[152] Robbins, C. S., and B. A. Dowell. 1989. Habitat Area Requirements of Breeding Forest Birds of the Middle Atlantic States. Wildl. Monogr. 103. 34pp.

[153] Hoover, J. P., and M. C. Brittingham. 1993. Regional Variation in Cowbird Parasitism of Wood Thrushes. Wilson Bull. 105:228-238.

[154] Freemark, K. E., and B. Collins. 1992. Landscape Ecology of Birds Breeding in Temperate Forest Fragments. Pages 443-454 *in* J. M. Hagan and D. W. Johnston, eds, Ecololgy and Conservation of Neotropical Migrant Landbirds. Smithsonian Inst. Press, Wash. DC.

the analysis for the Arrowhead-Weston Transmission Project all forest blocks greater than 200 acres were analyzed for forest fragmentation impacts.) (See Chapter 6 for details.)

Forest fragmentation impacts are not limited to bird populations; they also have a significant impact on rare and important forest plant species and communities. Forest fragmentation can adversely affect species in several ways:

- Direct loss of habitat - Some species require large undisturbed blocks of interior forest habitat for nesting, breeding, or other activities necessary for their survival. Because large blocks of undisturbed forest are relatively rare, many of these species are also rare. Further loss of interior habitat and creation of increasingly smaller patches of suitable habitat can greatly affect their long-term survival. Some examples of species that require forest interior for long-term survival include fishers, pine martens, timber wolves, red-shouldered hawks, many passerine birds, such as warblers and flycatchers, and a number of woodland plants.
- Edge effect and increased competition - New clearings alter the vegetation and animal life both within the ROW and up to several hundred feet into the adjacent forest. Studies of power line ROW in forested habitat show a decrease in the density of interior forest species with increasing proximity to the ROW, while the density of edge species increased along the forest-edge interface.[155] Increased sunlight and wind penetrate the forest edge and create conditions that favor plant species more tolerant of light and drier conditions. Many of the plants and the animals that prefer edge habitat are very common species that can readily out-compete native plants and animals, because of their opportunistic behaviors and greater tolerance to a wide range of environmental conditions. Some examples of species favored by creating edge include raccoons, skunks, cowbirds, blue jays, crows, white-tail deer, garlic mustard, buckthorn and box elder trees. Some edge species, such as the white-tailed deer, through selective consumption of forest plants, can have a significant adverse impact on the vegetative structure and composition of a forest.
- Isolation effects - The cleared corridors may also create a barrier to movement for some species. This eventually leads to a decrease in genetic variability, leaving the remaining species and populations more susceptible to disease, and less able to respond to habitat changes.

General loss and degradation of forest habitat

The activities associated with clearing trees and constructing a transmission line through or along the edge of forested areas can destroy and degrade forest habitat. Seeds or other propagative parts of non-native plants may be carried into a forest inadvertently by construction equipment and disturbance caused by construction can encourage aggressive growth of these species.

[155] Kroodsma, R. L. 1982. Edge Effect on Breeding Forest Birds along a Power-line Corridor. J. Applied Ecol. 19:361-370.

Habitat providing food and cover for local wildlife may be altered or lost if these invasive species out-compete existing native plants, resulting in a loss of plant and animal diversity.

Trimming and clearing trees at certain times of the year can also contribute to the spread of oak wilt disease. Red oak, black oak, and Northern pin oak are especially susceptible to the disease and will often die within one year of infection. The cause of the disease is a fungus that is carried by sap-feeding beetles or spread through common root systems. In the upper Midwest, pruning or removal of oaks should be avoided during late spring and early summer, when the fungus most commonly produces spores.

Pulp and timber losses

The production of trees for pulp and timber use is an important industry in northwestern Wisconsin. Pulp and timber production occurs on land owned by corporations associated with the pulp and paper industry and also on privately held lands. Because transmission line ROWs must be kept clear of woody vegetation that grows taller than 10 to 12 feet, the area within a ROW is permanently displaced as a site for pulp and timber production.

Effects on land in managed forest programs

Private woodlands enrolled in Wisconsin forest tax law programs, such as the Forest Crop Law or Managed Forest Law programs, could be affected on a long-term basis by construction of a power line through the property. The tax benefits of participating in these programs are substantial for owners of large forested blocks, especially if landowners open their land to the public for recreational purposes. Eligibility for the program requires that no more than 20 percent of the land be in a non-productive state (not growing trees).

Clearing trees for a power line ROW permanently removes wooded acreage from timber production. If the amount of productive land falls below 20 percent because of a transmission line ROW, the property would be allowed to remain in the program until the current contract expires. However, the status of future enrollment would be in question. Loss of private lands from these programs can result in a substantial monetary loss for woodland land owners and it could also have an adverse effect on recreation across the state, since landowners that receive the largest tax breaks must open their land for hunting, fishing, hiking, and cross-country skiing.

Sugar bush operations

Sugar maple trees can be tapped to provide maple sap, the raw material from which maple syrup and maple sugar are derived. Because all large trees would be removed from a transmission line ROW, a line passing through a grove of sugar maples tapped for sap collection (a sugar bush) would reduce the number of producing trees. Maple trees at the edge of a grove are less productive than those located in a grove interior. Exterior trees are also more susceptible to wind damage. A transmission line could increase the proportion of exterior trees by dividing a grove into smaller parts. These factors would combine to reduce the production in any sugar bush crossed by a transmission line.

Many commercial sugar bushes use a vacuum line sap collection system instead of the more familiar tap and bucket. A transmission line could induce a static electric charge in wires used to support vacuum hoses, if the wires are parallel the line. Grounding of the support wires may be necessary to prevent a shock hazard. The vacuum hoses would need to be removed from the transmission line ROW to allow construction and maintenance equipment to travel along the ROW. Consequently, a vacuum collection system may not be practical in a sugar bush that is bisected by a transmission line.

Electric and Magnetic Fields (EMF)

Sources of fields

Concerns over exposure to EMF are often raised during power line construction cases. Exposure to power line electric fields was investigated in the early 1970s and no adverse health effects were discovered. However, in the late 1970s, researchers began to focus on exposure to magnetic fields and the potential for adverse human health effects. This issue has yet to be fully resolved, because scientific studies investigating the potential human health effects of exposure to EMF have resulted in conflicting findings and interpretations.

Electric and magnetic fields occur whenever and wherever we use electricity. A magnetic field is created when electric current flows through any conductor such as a power line or the electrical wiring in a home. Other sources of magnetic fields include electrical appliances such as power tools, vacuum cleaners, microwaves, computers, electric blankets, fluorescent lights, and electric baseboard. Because there are so many common sources of EMF, we are exposed to a wide variety of magnetic fields every day.

Results of EMF research

Scientists have uncovered only weak and inconsistent epidemiological associations between exposure to power frequency EMF and human health. Several epidemiological studies have shown a statistical association between the risk of childhood leukemia and the kind of electrical wires outside the home. However, other epidemiological studies have found no link to leukemia. Cellular studies and studies exposing test animals to EMF have shown no link between EMF and disease. Taken as a whole, the biological studies conducted to date have not been able to establish a cause-and-effect relationship between actual magnetic field exposure and human disease, nor have scientists been able to identify any plausible biological mechanism by which exposure to power frequency EMF might cause human disease.

If you are interested in a more detailed review of EMF research and human health refer to Appendix D. Details about the expected EMF levels associated with the proposed power line designs can be found in Chapter 6.

Pacemakers and implantable defibrillators

Exposure to magnetic fields produced by the proposed power line will not affect pacemakers and implantable defibrillators. There may be some circumstances, however, where exposure to the electric field produced by this line may result in inappropriate pacing for pacemakers or

inappropriate operation of defibrillators. Refer to the discussion on pacemakers and defibrillators in Appendix D.

Induced currents

The information that was provided within this section of the draft EIS has been moved to the Safety section later in this chapter, under the subsection titled "Induced voltages."

Noise

Transmission lines can produce noise under certain conditions. Some people have reported that vibrations or a humming sound are sometimes heard under particular wind conditions and for particular lines. Loose hardware or loose connections between the conductors, insulators, and the poles may cause noise on the lines in strong winds. In foggy, damp, or rainy weather conditions, power lines can cause a subtle crackling sound because a little of the electricity ionizes the moist air near the wires. Ionization in foggy conditions can also cause corona, which is a luminous blue discharge of light, usually where the wires connect to the insulators. Ionization occurs most often in high-voltage 345 kV lines and less often in 161 kV or 115 kV lines. More information about unexpected noise levels for the proposed project can be found in Chapter 6.

Property values

The potential for changes in property values due to the proximity to a new power line has been well documented.[156] Real estate appraisers, utility consultants, and academic researchers have studied the issue of how to assess the impacts of power lines on property values since the 1950s. In general, there are two types of property value impacts that can be experienced by property owners affected by a new transmission line. The first is a potential economic impact associated with the amount paid by a utility for a ROW easement. The second is the potential economic impact involving the future marketability of the property. Although somewhat interrelated, these two effects are discussed separately below.

Just compensation for a transmission line easement has been typically interpreted as the difference between the fair market price of the land with and without the encumbrance of the line. Economic impacts to landowners could occur if they are not compensated for the "highest and best use" of the affected parcel or if the effective "taking" is larger than the actual easement. In addition, adjacent property owners are generally not compensated at all, even if certain uses

[156] Approximately 30 papers, articles, and court cases covering the period 1987 through 1999 were reviewed by Commission staff in its analysis of this subject.

of their land are adversely affected.[157] A number of court cases involving these issues have resulted in differing opinions and decisions about what constitutes just compensation.

Potential impacts related to the marketability of a property include factors such as sale price, the amount of time required to sell, and the debt carried over this time. The types of studies done to assess changes in sale price of property containing a transmission line have evolved over time. Initial studies were primarily surveys or attitudinal studies of small numbers of homeowners. However, substantial differences may exist between people's perceptions about how they would behave and their actual behavior when confronted with the purchase of property supporting a power line.

Because of this uncertainty, attitudinal studies were replaced by "valuation" studies involving the comparison of sales prices for properties similar in most respects, except for proximity to a power line. The potential shortcomings in conducting these types of studies are: (1) identifying what constitutes a pair of virtually identical properties is often a matter of subjective judgment and (2) a limited number of suitable pairs is often used to represent the "market."[158] A study conducted in west central Wisconsin in the mid-1980s, used the comparable pair sales evaluation of residential properties.[159]

A third type of research study to assess property value effects involves large sample sizes, a high number of variables and multiple regression analysis. These studies, which can better account for numerous variables that affect sales, provide the best information to date on the effects of power lines on property values.

When buying property, people are likely to consider many factors, such as schools, community services, scenic beauty, recreational opportunities, or distance to work. The relative importance of each of these factors varies among individuals. Likewise, the importance of a nearby power line varies among people.

A power line may either increase or decrease an individual's perception of a property's worth. This perception is indicative of how much one is willing to pay for the property (the fair market value).

---

[157] Furby, L., Robin, G., Slovic, P., and Fischoff, B. 1988. Electric Power Transmission Lines, Property Values, and Compensation. J. Env. Mngmt. 27:69-83.

[158] Kinnard, W. Jr. and S. A. Dickey. 1995. A Primer on Proximity Impact Research: Residential Property Values Near High-Voltage Transmission Lines. Real Estate Issues 20(1):23-29.

[159] Solum, C.L. 1985. Transmission line impact study based on paired sale comparisons of residential properties located within Northwest and West Central Wisconsin. Craig L. Solum & Assoc.

The perceived value of a piece of property could increase if:

- A cleared ROW provides better access to interior lands or water.
- A cleared ROW creates an opening that enhances the area for certain wildlife.
- A cleared ROW provides open space that is used for gardening or recreation.
- Increased local electrical reliability enhances opportunities for development of commercial or industrial interests.
- In rural areas, especially in the vicinity of large wooded parcels, utility ROW may provide improved access for hunting, snowmobiling, or other recreational activities. White-tailed deer and some other animals use forest openings for foraging and travel. In urban or suburban residential areas, lots on or adjacent to power line corridors are often sized larger than neighboring lots but similarly priced, allowing residents to benefit from the added buffer and space the ROW provides. Integrating the open space of the utility corridor into a neighborhood and developing it as usable space can also diminish or avoid adverse effects on property values. 160
- Conversely, the perceived value of property may decrease in value because of:
- Concern or fear of possible health effects from electric or magnetic fields.
- The potential noise and visual unattractiveness of the transmission line.
- Potential interference with farming operations or foreclosure of present or future land uses.

While no conclusive evidence of the effects of EMF on health exists, it is recognized that people's concerns about this issue can influence their decisions related to purchase of property. In *Criscuola v. Power Authority of the State of New York*,[161] the New York State Court of Appeals ruled that whether the danger of EMF is a scientifically genuine or verifiable fact should be irrelevant to the central issue of its market value impact. The visual profile of transmission lines structures and wires can also decrease the perceived aesthetic quality of property. These conclusions have been cited in several court cases and legal opinions.

On properties that are farmed, installation of a power line can remove land from production, interfere with operation of equipment, create safety hazards, and foreclose the opportunity to consolidate farmlands or develop the land for another use. The greatest impact on farm property values is likely to occur on intensively managed agricultural lands.

---

[160] Ignelzi, Patrice and Thomas Priestley. A Statistical Analysis of Transmission Line Impacts on Residential Property Values in Six Neighborhoods. Southern California Edison, 1991.

[161] *Criscuola v. Power Authority of the State of New York*, 81 NY2d 649, 602 NYS2d 588, 621 NE2d 1199 (1993).

Lastly, the presence of a power line may not affect some individuals' perceptions of a property's value at all. These people tend to view power lines as necessary infrastructure on the landscape, similar to roads, water towers, or antennae. They generally do not notice the lines nor do they have strong feelings about them.

While the data from many of the studies reviewed are often inconclusive, some general observations among the studies are:

- The potential reduction in sale price for single-family homes may range from 0 to 14 percent.[162]
- Adverse effects on the sale price of smaller properties could be greater than effects on the sale price of larger properties.
- Other amenities, such as proximity to schools or jobs, lot size, square footage of a house, and neighborhood characteristics, tend to have a much greater effect on sale price than the presence of a power line.
- The adverse effects appear to diminish over time.
- Effects on sale price are most often observed for property crossed by or immediately adjacent to a power line, but effects have also been observed for properties farther away from a line.
- The value of agricultural property is likely to decrease if the power line poles are placed in an area that inhibits farm operations.

With respect to the second to last point, homes not directly adjacent to the ROW or beyond 200 feet from the ROW were affected to a much lesser degree than those abutting the line or ROW.[163] [164] It is very difficult to make predictions about how a specific transmission line will affect the value of specific properties. The property values effects discussed in this section are on "fair market" value. No studies have indicated that there may be an effect on the "assessed" value of property.

Radio and television interference

Power lines do not usually interfere with normal television and radio reception. In some cases, interference is possible at a location close to the ROW due to weak broadcast signals or poor

[162] The values can vary widely depending on the area of the United States. In coastal states, such as California and Florida, the decrease in property values can be quite dramatic; in states within the Midwest (Minnesota, Wisconsin and the Upper Peninsula of Michigan), the average decrease appears to be between 4 percent and 7 percent.

[163] Kung, H. and C. Seagle, "Impact of Power Transmission Lines on Property Values: A Case Study," Appraisal Journal, July 1992.

[164] Hamilton, S. and G. Schwann. 1995. Electric Transmission Lines and Property Value. Land Economics 71(4):436-444.

receiving equipment. If interference occurs because of the power line, the electric utility is required to remedy problems so that reception is restored to its original quality.

Recreation impacts

Recreation areas include parks, trails, lakes, or other designated areas where recreational activities occur. Power lines can affect recreation areas in several ways:

- Limiting the location of buildings.
- Repelling potential users whose activities depend on the aesthetics of natural surroundings (e.g. backpackers, canoeists, hikers).
- Altering the types of wildlife found in an area (e.g. by creating edges) or endangering wildlife (e.g. by interfering with waterfowl flight patterns).
- Providing paths or better access to previously inaccessible areas for those who snowmobile, ski, bike, hike or hunt.

Some of these effects can be mitigated by locating lines along property edges, screening the lines, using pole designs to minimize aesthetic impacts, or designing recreation facilities to take advantage of cleared ROWs.

Safety

Safety standards

Transmission lines must meet the requirements of the Wisconsin State Electric Code.[165] The code establishes design and operating standards, and sets minimum distances between wires, poles, the ground, and buildings. Although the code represents the minimum standards for safety, the electric utility industry's construction standards are generally more stringent than Wisconsin State Electric Code requirements.

The minimum horizontal clearance required between a building and a 345 kV conductor is approximately 19 feet, but many other factors determine good engineering design distances, such as displacement of the conductors by the wind. Wis. Admin. Code § PSC 114.234A4 prohibits the construction of high-voltage electric transmission lines over occupied residential dwellings or residential dwellings intended to be occupied. Although they may not be prohibited by code, building other structures within a transmission line ROW is strongly discouraged.

[165] Wisconsin adopts the most recent edition of the National Electric Safety Code (NESC-1997) with certain changes, deletions and additions. Volume 1 of the Wisconsin State Electrical Code is found in Wis. Admin. Code. ch. PSC 114. It is administered primarily by the Commission.

Contact with transmission lines

The most significant risk of injury from any power line is the danger of electrical contact between an object on the ground and an energized conductor. Contact with the energized wires of high-voltage transmission lines is less of a problem, due to their height, than lower-voltage distribution lines and customer service drops. In addition, transmission lines are designed to automatically trip out of service (become de-energized) immediately if they fall.

When working near high-voltage transmission lines, it is important to know that electrical contact can occur, under certain circumstances, even if direct physical contact is not made. In the case of high-voltage transmission lines, electricity can arc across an air gap. The most important safety practice is to avoid placing yourself or any object you are in contact with too close to a high-voltage overhead line. As a general precaution, do not put yourself oon an object or in contact with any object that is taller than 15 to 17 feet, under an overhead high-voltage electric line.[166] Individuals with specific concerns about whether it is safe to operate their vehicles or farm equipment in a particular location near an electric transmission line should contact their electricity provider directly.

Induced voltages

Landowners, especially farm operators, often express concerns about shocks from metal objects in the immediate vicinity of an overhead transmission line. An ungrounded metal object (e.g. tractors, fences) under or very near an energized transmission line may become charged with low-level, 60 Hz, AC voltages by an electrostatic induction process. When a person or animal touches the object, a shock may be felt, similar to that felt after crossing a carpet and then touching a metal object. The voltage discharge can be a painful nuisance. Dissipation of such charges occurs when contact is made with the ground. This might happen when people, livestock or some other conductive material makes an effective electrical contact between ground and the charged object. The magnitude and strength of a charge is directly related to the mass of the ungrounded metal object and its orientation to the line.

Utilities' experience with induced voltage concerns related to existing 345 kV transmission lines has been very limited to date. In the past nine years, only three situations have required WPSC to conduct an on-site investigation to mitigate induced voltage problems. In two cases, the concerns were addressed by providing a means of grounding for the objects in question. In the third situation, an under-built distribution line was partially relocated underground to solve the problem.

Fences directly under and in parallel to transmission lines should be grounded to earth. This can be achieved through the use of a simple ground rod with an insulated lead and a wire clamp attached. Energized electric fences, if properly installed with the appropriate fence grounding electrode system, should continue to function properly even when subjected to induced voltage.

---

[166] DATCP, Agricultural Impact Statement, June 2, 2000, pgs. 63-64.

Energized electric fences directly under or in parallel with a transmission line may also have filters installed to discharge the 60 Hz induced voltage to earth.

When it is necessary to move or work on such fences, the fences should remain solidly grounded while doing the needed maintenance. Additional protection may be obtained by installing an approved lightning protection system on the fence that also provides a means for ready discharge of induced voltage. Individuals should consult the installation instructions or the Midwest Rural Energy Council (formally known as the Wisconsin Farm Electric Council) publication for electric fences, "Installation and Operation of Electric Fences, Cow Trainers and Crowd Gates." Individuals with specific concerns regarding the operation of equipment or placement of fences under an electric transmission line should contact their electricity provider directly.

When working with equipment (e.g. tractors) under a transmission line, a very low-cost, effective, mitigation technique is to drag a short metal chain from the insulated equipment to "ground it out" to earth. An alternative, when getting off of the equipment, is to drop a chain that is attached to the metal frame of the equipment to the ground prior to disembarking; the chain could be pulled up while the equipment is moving to reduce the risk of the chain breaking and damaging any trailing equipment. The most direct mitigation measure is to avoid parking this type of equipment under high-voltage power lines.

Refueling vehicles directly under a high-voltage transmission line is not a good practice. A spark from discharging a metallic structure with induced voltages to earth could ignite the fuel. The risk of such ignition is higher with gasoline powered vehicles than for diesel fuel powered vehicles.

The DATCP's AIS for this project provides additional information regarding safety issues when farming near transmission lines. To obtain a copy of the AIS, call (608) 224-4650. DATCP's AIS provides a copy of the Bonneville Power Administration's (BPA) handout: *Living and Working Safely Around High-Voltage Power Lines*. To obtain a separate copy of the BPA's handout call 1-(800)-622-4520; the document number is DOE/BP 1821.

Lightning

Transmission lines are usually built with a grounded shield wire at the top of the poles. Typical utility construction practice is to bond the shield wire to ground at each transmission structure or pole. This protects the power line from lightning. Power poles, like trees or other tall objects, may be more likely to intercept nearby lightning strikes, but do not "attract" lightning. Lightning is not more likely to strike houses or cars near a power line. Shorter objects under or very near a line may actually receive some protection from lightning.

Social concerns

Social concerns are often raised by individuals living along proposed transmission line routes. Two common issues are "users versus payers" and "freedom of choice versus powerlessness."

"Users versus payers" is the concept that groups using the most electricity should bear the impacts of the facilities that are required to meet that use. This is an issue of fairness that may pit rural areas against suburban or urban areas.

The concept that users should pay arises from:

- Increasing pressure for competing land uses.
- Repeatedly imposing on one group in society.
- The belief that money cannot compensate for all of the environmental costs that a power line creates.

The money paid to landowners for easements is meant to compensate them for having the line built on their property. These easement payments are usually negotiated between the landowner and the utility. Many landowners question whether these payments are high enough or whether any amount of easement payment can actually compensate for their losses.

Additional compensation could be received by towns and municipalities affected by the line through the payment of impact fees required by 1999 Wisconsin Act 9. (See Chapter 1.)

The other issue that surfaces frequently in transmission line cases is "freedom of choice versus powerlessness." Limitations on property use due to easement restrictions may seem like an invasion of privacy or loss of control over property use. EMF concerns caused by the placement of a power line near a dwelling raise similar issues about the inability to make personal choices related to health and life styles. Although household wiring, appliances, and certain machinery can produce high EMF, people feel that they have greater choices and control over their use of appliances and their choice of jobs than over the location of a power line.

Finally, corridor sharing policies that favor placement of a new transmission line within or next to an existing infrastructure corridor may burden some landowners with multiple easements and significant property use restrictions. These hardships must be balanced against the potential to reduce environmental impacts caused by development of a new ROW corridor.

Stray voltage and dairy livestock

Stray voltage has been studied in many research projects at accredited universities over the past 20 years. These projects have examined the causes and effects of various levels of stray voltage, and means for mitigating the effects. Wisconsin, through the PSCW and the DATCP, has much more regulatory oversight concerning stray voltage than other states in the country. Wisconsin utilities have allocated more resources, financial and otherwise, to this issue than most other utilities nationwide.

Stray voltage is an electrical phenomenon that can often be found at low levels between two animal contact points at any livestock confinement where electricity is grounded. Electrical systems, including farm systems and utility distribution systems, must be grounded to the earth

according to the National Electric Safety Code (NESC) to ensure safety and reliability.[167] Inevitably, some current flows through the earth at each point where the electrical system is grounded and a small voltage develops. This voltage is called neutral-to-earth voltage (NEV). When NEV is measured between two objects that may be simultaneously contacted by an animal, it is considered stray voltage.

Low levels of AC voltage on the grounded conductors of a farm wiring system are a normal and unavoidable consequence of operating electrical farm equipment. The key is understanding what levels of stray voltage do and do not affect farm operations. Stray voltage often is not noticeable to humans, yet may be felt by an animal. For example, a dairy cow, while standing on the earth or a concrete floor, may feel a small electric shock when it makes contact with something that is energized, such as a feeder or water bowl.

Dairy cow behaviors that may indicate the presence of stray voltage include nervousness at milking time, increased defecation or urination during milking, hesitation in approaching waterers or feeders, or eagerness to leave the barn. A stray voltage problem may be reflected in increased milking time and in uneven milking, sometimes with decreased milk production. Some problems erroneously associated with stray voltage are increased mastitis and milk-withholding problems on farms with milking parlors or in barns with milk pipelines. Many other non-electrical farm factors cause these symptoms.

Measurement of any voltages or current flow in livestock confinement areas can be done using established testing procedures with appropriate equipment.[168] Mitigation of any such currents can be achieved through a variety of proven and acceptable means, such as additional grounding or the installation of an equipotential plane or isolation if necessary.

The PSCW formed the Wisconsin Rural Electric Power Services (REPS) program to conduct on-farm investigations and collect data. The PSCW ordered the major investor-owned Wisconsin utilities to record findings from their stray voltage investigations and release these findings to the PSCW. The DATCP also has a stray voltage unit. It provides a veterinarian to the REPS program and provides information to farmers about how to reduce stray voltage if high levels are found on the farm.

---

[167] Wis. Adm. Code § PSC 114-096C requires a primary neutral ground at every pole in rural areas, for new construction. The intended purpose is to improve grounding in rural areas.

[168] Commission staff recently issued a White Paper Report: Measurement Protocols - Facts and Misconceptions. This white paper discusses established testing methodologies for stray voltage investigations. The white paper is available via the Commission's website at the following address: http/www.psc.state.wi.us/writings/papers/energy/strayvol/intwhite.htm.

The PSCW established a stray voltage "level of concern," in 1996 of 2 milliamps.[169] The "level of concern" is not intended as a damage level. Rather, 2 milliamps is a very conservative, pre-injury level, below the point where moderate avoidance behavior is likely to occur and well below where a cow's behavior or milk production would be affected. The PSCW and DATCP consider that this level of voltage/current is an amount of electricity where some form of mitigative action should be taken on the farmer's behalf, although only a small percentage of cows may perceive its presence.

The "level of concern" is further defined with respect to how it should be reduced. If a utility distribution system contributes one milliamp or more to stray voltage on a farm, the utility must take corrective action to reduce its contribution to below the one milliamp level. Further, if the farm electrical system contributes more than one milliamp, the farmer may want to consider taking corrective measures to reduce the level below one milliamp.

From 1994 through 1998, the PSCW and the DATCP participated in a collaborative effort, organized by the Minnesota Public Utilities Commission (MPUC), which studied evidence and conducted independent analysis concerning claims that electric and magnetic fields are responsible for problems with animal behavior, health and production problems of dairy cows. This collaborative process involved a multidisciplinary group of Science Advisors with expertise in the fields of agricultural engineering, animal physiology, biochemistry, electrical engineering, electrochemistry, epidemiology, physics, soil science and veterinary science.

On July 31, 1998, the *Final Report of the Science Advisors to the Minnesota Public Utilities Commission: Research Findings and Recommendations Regarding Claims of Possible Effects of Currents in the Earth on Dairy Cow Health and Milk Production* was issued by the MPUC. The Science Advisors' conclusions were as follows:

1. We have not found credible scientific evidence to verify the specific claim that currents in the earth or associated electrical parameters such as voltages, magnetic fields and electric fields, are causes of poor health and milk production in dairy herds.

2. At the present time, there is no basis for altering the PUC-approved standards by which electric utilities distribute power onto or in the vicinity of individual.

3. There are many well-documented non-electrical factors that are known and accepted by the scientific community, and by most farmers as well, to cause dairy cow health and production problems. Among the most noteworthy stressors are poor nutrition, poor cow comfort and hygiene, and low or no use of vaccinations and related preventive veterinary practices. Those who want to improve performance of dairy herds should always address these factors.

[169] In PSC docket 05-EI-115 the level of concern was established at 2 milliamps, AC rms (root mean squared), steady state or 1 volt AC rms steady state across a 500 ohm resistor in the cow contact area. Steady state is defined by the Institute of Electrical and Electronics Engineers (IEEE) as the value of current or voltage after all transients have decayed to negligible value.

In addition, the report states, in part: "…with the present body of evidence, it is our best judgment that magnetic fields from earth currents or any other contributory sources in the dairy barn are not of sufficient levels to cause any health or production problems in dairy cows."[170]

Transmission lines, such as the proposed Arrowhead-Weston Transmission Project, have seldom been shown to contribute to stray voltage problems as long as there is proper grounding of all metal structures in close proximity to the line. (See Induced voltages in this chapter.) In those instances when transmission lines have been shown to contribute to stray voltage, the electric distribution system was built directly under and parallel to the transmission line. Such construction may result in "induced voltage" from the transmission line upon the distribution system, which could result in high NEV that might contribute to stray voltage on an adjoining farm.

The proposed design for the 345 kV Arrowhead-Weston Transmission Project does not include any electric distribution underbuild on the 345 kV transmission line structures. However, approval of the Tripoli 1 and Tripoli 2 Routes would result in the need to construct new 115 kV transmission line connections between a relocated NSP 115 kV transmission line and the Catawba and Hawkins Substations.[171] These 115 kV connections are proposed to include distribution underbuild. Numerous route segments along the various routes for the 115 kV Tripoli to Rhinelander transmission line may be constructed with electric distribution lines underbuilt upon the transmission line structures.[172]

Visual impacts

Transmission lines are often routed to avoid areas generally considered scenic. Lines routed through areas with more compatible land uses, such as commercial/industrial areas or along existing infrastructure corridors (roads, electric lines, or railways), or along land use boundaries have less visual impact than lines in landscapes valued for their scenic and recreational qualities.

---

[170] Id., pg. 39.

[171] The route segments that would connect the relocated NSP 115 kV transmission line following the Tripoli 1 Route to the Catawba and Hawkins Substations are Segments 159v and 161v, respectively. The route segments that would connect the relocated NSP 115kV transmission line following the Tripoli 2 Route to the Catawba and Hawkins Substations are segments 158v and 160v, respectively.

[172] Exit routes from Tripoli substation sites 8 or 9 to North or Central Routes- Segment 471; Exit routes from Tripoli Substation sites 8 or 9 to South Route - Segment 476; Exit routes from Tripoli Substation sites 1 & 2 to North or Central Routes- Segment 471; North Route - Segments 441a, 441b, 442; Central Route - Segments 433a, 435, 438, 444, 457, 458; Railroad Route-410, 414, 424a; Highway 8 Route - Segments 410, 414, 424a; Cross County Route - Segment 415z.

ROW management techniques can also be implemented to mitigate visual impacts. Some of these techniques include planting vegetative screens to block views of the line, leaving the ROW in a natural state at road crossings, creating curved or wavy ROW boundaries, pruning trees to create a feathered effect, avoiding soil erosion, and screening and piling brush from the cleared ROW so that it provides wildlife habitat.

The visual impact of utility structures can be separated into four components: form, line, color, and texture. To avoid extensive visual impacts, line design can be used to blend the line into its surroundings as much as possible. Certain power line designs can make a line less obtrusive. Poles can be colored to blend with or complement the landscape around them. Construction materials for poles can be chosen so that textures blend with or complement the landscape around them. Stronger conductors can be used to minimize sag and provide sleeker line profiles.

Placing a power line underground usually decreases aesthetic impacts by removing the power line from sight. However, some underground lines need obtrusive overhead facilities (transition stations that allow the conversion from overhead to underground). Visual impacts may also increase because bushes and small trees, in addition to tall-growing trees, would have to be cleared from the underground transmission line ROW.

Water Resources

River and stream crossing impacts

Creeks, streams, rivers and lakes are abundant throughout Wisconsin. Many of these rivers have been designated as special resources that have state, regional, or national significance. Construction and operation of transmission lines across these resources may have both short-term and long-term effects. The type and significance of power line impacts on rivers and streams will vary depending on the characteristics of the water resource. River use, physical features such as channel width and water quality, and the scenic quality of the river and its surroundings are important factors in assessing the potential impacts.

Soil erosion during construction caused by driving vehicles through streams, building temporary bridges, or ROW clearing activities can decrease water quality. Clearing overhanging trees and brush can result in increased water temperatures, reducing habitat quality for fish and other aquatic species. Overhead transmission lines across major rivers and streams may have a visual impact for river users and pose a potential collision hazard for waterfowl and other large birds, especially when located in a migratory corridor.

Boring or trenching a transmission line underground to cross a river eliminates the presence of wires directly above the river, but may require additional infrastructure adjacent to the river. In situations where a fluid-filled underground pipe is used, a pumping station may be needed to maintain the pressure of the insulating fluids. Transition stations that convert the underground cables to an overhead design would also be needed on both sides of the waterway.

Boring and trenching technologies and their associated environmental impacts are described in more detail below:

Horizontal directional drilling (HDD) involves drilling a 3-inch diameter horizontal pilot hole through the substrate beneath the riverbed. The pilot hole is drilled with a magnetic steering tool, which controls both horizontal and vertical position. The pilot hole is progressively enlarged until an adequate diameter is achieved. Casing and cable are then pulled through the bore-hole and connected to the underground land-based portions of the line. Entry and exit locations are then backfilled and restored. HDD technology does involve some environmental risks. During construction, a bentonite slurry (an inert clay material) is continuously forced through the bore-hole to lubricate the rotating drill head. If a fissure in the bedrock is encountered or caused by drilling, the bentonite slurry could leak into the river. If the leak is large or the river current does not rapidly disperse the bentonite, the sediment could adversely affect water quality and any aquatic organisms, such as mussels, that are present near the fissure. In cases where the bedrock is extremely hard, drill bits can break or become lodged in the bore-hole, requiring the drilling of another hole. Finally, the entry and exit sites for the drilling operation can be heavily disturbed during the drilling process. It is, therefore, important that reclamation of these sites be included in the construction contract.

Direct lay trenching across a river is similar to land-based trenching with the complication of working underwater and in a riverbed. This construction method requires diverting the main flow of the river while trenching, assembling casing on floating platforms, attaching weights to the casing, lowering the casing into the open trench, anchoring, and finally covering the trench with clean backfill and protective sand-cement bags. The technical difficulty and potential for adverse environmental effects associated with direct lay trenching can be substantial, especially in a wide and fast-flowing river or stream. Potential problems include destruction of bottom-dwelling organisms due to massive disturbance of the river bottom, erosion and sedimentation from the spoil pile during construction, and permanent changes in the flow and sedimentation patterns. A failure in one or more cables that are trenched in could require more disturbance when locating and repairing the fault.

Techniques for minimizing adverse effects of power lines in river and stream environments include: designing the line to span the resource; avoiding pole placement in or immediately adjacent to the resource; using DNR-approved erosion control methods; marking shield wires if the potential for bird collisions is high; landscaping to screen the poles from view of river users; and maintaining shaded stream cover where possible. Also, use of temporary bridge structures or matting to avoid driving equipment across streams should be considered.

Permitting process for river and stream crossings

There are several state and federal laws that protect streams and their associated wetlands. The discussion below outlines these legal protections and the permitting requirements for activities affecting streams.

- Wis. Stat. § 30.29 prohibits motor vehicle crossings of navigable waters (except when frozen), but allows DNR to issue permits for specific crossings for special purposes.

- Wis. Stat. § 30.025 describes an alternate process for permitting utility crossings of multiple streams. This procedure requires that the applicants submit an engineering plan within 20 days after submitting a CPCN application. The applicants for this project did not submit a stream crossing engineering plan to DNR within 20 days of their filing at the Commission.
- 33 USC 403 Section 10 of the Rivers and Harbors Act of 1899 prohibits the unauthorized obstruction or alteration of any navigable waters of the United States. Several rivers crossed by the transmission line are designated Section 10 waters and a COE permit would be required prior to construction of the line across these waters.
- 16 USC 1271-1287 Section 7a prohibits federal agencies from authorizing a water resources project that would have a direct and adverse effect on the values for which a river protected by the Wild and Scenic Rivers Act was established.

The following permit process steps would occur if the Commission approves the proposed project:

1. The applicants would determine which pole locations require crossing a stream away from an existing bridge or road.

2. The applicants would apply to the COE for any permits required for Section 10 waters and submit an application to the NPS for crossing the Namekagon River and any other rivers listed or proposed to be included in the NRI.

3. The applicants would apply to DNR for stream crossing permits under Wis. Stat. § DNR ch. 30.

4. The DNR, the COE, and the NPS would review the proposed sites to determine the need for surveys and assess potential impacts on threatened and endangered species, cultural resources, recreation, scenic beauty, water quality, and tribal trust concerns. An environmental impact statement or an environmental assessment would be prepared by federal agencies to satisfy NEPA requirements.

5. The permits would be denied or granted contingent on mitigation procedures required to protect stream quality, state and federal listed species, and recreational and scenic values.

Public notification, a public comment period, and the opportunity to request a hearing would occur prior to the issuance of any permits.

A CPCN granted by the Commission would need to be contingent upon the applicants' ability to secure all necessary permits from state and federal agencies. Likewise, any permit granted by the DNR or COE could be made contingent on the implementation of all mitigation procedures ordered by the Commission in its CPCN authorization.

Impacts on wetlands

Wetlands occur in many different forms. Some wetland meadows and marshes consist primarily of grasses, sedges, reeds and cattails. These wetlands may contain areas of open water on a permanent basis or only for a portion of the year. Shrub-carr wetlands support a mixture of grasses and sedges interspersed with shrubs, such as willows, alders, or dogwood. Open water may or may not be present in shrub-carrs. Wooded wetlands consisting of conifers or deciduous hardwoods represent another type of wetland common throughout northern Wisconsin. Tamarack, cedar, and black spruce swamps and bogs occur in many of the numerous isolated low-lying areas. Wetlands consisting of deciduous hardwoods, such as black ash, elm, and silver and red maple, tend to occur along creeks, rivers and streams.

Although wetlands are often thought of as "undevelopable wasteland," they serve several vital functions that benefit society. Wetlands store storm water runoff, enabling the recharge of groundwater sources. Wetlands filter sediments and pollutants from the air, precipitation and upstream sources, resulting in higher water quality in downstream water bodies and rivers. Wetlands provide food, cover, and nesting habitat for many species of fish and wildlife.

Functional changes

The construction and maintenance of power lines can damage the ability of wetlands to function as they should. Heavy machinery used for clearing trees and brush, drilling holes, hauling cement and setting poles can crush wetland vegetation and compact wetland soils. Soil compaction reduces the water-holding capacity of the soil and may result in increased runoff. Wetland soils consist of primarily organic matter (decomposed plant material). These soils are formed very slowly and if disturbed by digging, filling, and compaction they do not readily recover and are not easily repaired.

Changes in hydrology (the vertical and horizontal movement of water through the soil) caused by drilling holes, de-watering soils, installing foundations, and compacting soils can alter the vegetation, reduce plant diversity, and promote the growth of weedy species, such as purple loosestrife, which provide no food or nesting habitat for wildlife. Driving equipment in wetlands can stir up sediments, endangering fish and other aquatic life. In large wetland areas where access is limited, soil compaction and decreased hydrologic function can be further increased if fill is used to construct temporary or permanent roads or bridges for building and maintaining the line.

Certain wetland types appear to be more susceptible to long term changes in community structure and diversity due to power line construction. Forested wetlands, especially those supporting tamarack and black spruce over a sphagnum moss ground layer, recovered more slowly and to a lesser extent than deciduous shrub-scrub wetlands (supporting willows, alders, and sedges) and wet meadows.[173] The length of time needed for recovery of other types of

[173] Grigal, D. F.1985. Impact of Right-of-Way Construction on Vegetaton in the Red Lake Peatland, Northern Minnesota. Jour. Envir. Mgmt. 9(5):449-454.

forested wetlands, such as wooded swamps, appears to be somewhat faster than forested bogs, but slower than other non-forested bogs. In a ten-year study of three wetland types following construction of a transmission line in Massachusetts, species diversity and richness were similar to pre-construction levels within one year in a cattail marsh but took several years to rebound in a wooded swamp with a red maple and alder canopy. Damage caused by ROW construction was still apparent after ten years in a bog dominated by leatherleaf shrubs and sphagnum moss.[174]

Equipment access can be very difficult and result in a high potential for rutting and permanent alterations in soil structure in large areas of open water, such as shallow marshes or in areas supporting floating mats of vegetation.

Power line structures and conductors can also pose a collision hazard for sandhill cranes, waterfowl, and other large water birds, especially under low light conditions and in poor weather.

Techniques for minimizing adverse effects on wetlands include: spanning wetlands when possible; avoiding placement of power lines in wetlands, especially those that are not adjacent to roads or easily accessible; limiting construction to periods when wetland soils and water are frozen and vegetation is dormant; carefully cleaning construction equipment after working in areas infested by purple loosestrife or other known invasive non-native species; and marking shield wires in areas known to be frequented by waterfowl and other large birds.

Permitting process for wetlands

Both state and federal laws regulate certain activities in wetlands. When fill material is proposed to be placed in a wetland, a permit is required from the COE under the Clean Water Act, Section 404. Some activities that could adversely affect wetlands, such as tree and shrub removal, driving of construction vehicles, and drainage, are generally not covered by these regulations. Because this is a linear project, the COE would likely consider all of the potential impacts to wetlands under one permit.

When a Clean Water Act Section 404 permit is required, the DNR must determine if the proposed activity is in compliance with applicable state water quality standards. The state's wetland water quality standards are found in Wis. Admin. Code chs. NR 103 and 299. If a proposal is found to be in compliance with state standards, DNR would provide "water quality certification" to the COE. Without this state certification, a federal permit is not valid.

If the project would result in impacts to wetlands associated with waters of the state, then the DNR may have primary authority under Wis. Stat. ch. 30. In such cases, compliance with state law is considered compliance with federal law.

The general process for obtaining a permit is:

---

[174] Nickerson, N. H., R.A. Dobberteen, and N.M. Jarman. 1989. Effects of Power-Line Construction on Wetland Vegetation in Massachusetts, USA. Jour. Envir. Mgmt. 13(4): 477-483.

1. The applicants send a permit application to COE.

2. COE forwards a copy of the application to DNR.

3. COE reviews the project according to federal guidelines including consideration of potential impacts on endangered species, cultural resources and tribal trust concerns.

4. COE denies or grants the permit contingent on the DNR providing water quality certification.

5. DNR reviews project for compliance with water quality standards. The review would cover specific sites, including any necessary field work (surveys for threatened and endangered species, determination of hydrologic conditions, and need for incidental take permits). Any finding of compliance would include specification of measures (COE permit conditions) to avoid or minimize wetland impacts at specific locations.

Both the federal and state processes allow for public notice, public comment, and legal challenge of decisions.

In addition to the protections for water resources provided by law that are described above, the Commission has the authority, in its final order in this case, to require avoidance of specific streams or wetlands, mitigation procedures for specific streams or wetlands, and independent monitoring of construction in all or specific streams and wetlands.

Wetlands Reserve Program lands

Some private lands within the project area are in the Wetlands Reserve Program (WRP). The WRP, a voluntary program funded by the USDA, offers a landowner payment for restoring, protecting, or enhancing wetlands on the landowner's property. The WRP provides an opportunity for farmers to retire marginal agricultural lands and reap the economic and social benefits of having wetlands on their property. The USDA's NRCS works with participating landowners through conservation easements and cost-sharing assistance for wetlands restoration.

The 1990 law allows for the purchase of permanent easements, 30-year easements, or 10-year cost-share agreements (without an easement). The landowner maintains ownership of the land and is responsible for taxes on easement lands. Public access is not allowed unless desired by the landowner. The NRCS and the USFWS determine eligibility of the acres offered in applications for enrollment according to (1) duration of the easement offer, (2) hydrology restoration potential, (3) habitat value for migratory birds and other wildlife, (4) wetland functions and values, (5) location significance, (6) wetland management requirements, (7) physical site condition, and (8) overall cost. Applications with the most environmental benefits and least cost are selected.

The landowner develops the plan for restoring the wetland in consultation with the NRCS, USFWS, DNR, and local conservation districts. The plan includes types of practices, necessary structures, and estimated costs. If a plan is accepted, a contract that involves a permanent easement, a 30-year easement, or a 10-year cost-share agreement is developed. The amount of the wetland restoration costs paid by USDA varies depending on the type of contract signed.

After WRP easements are established, use of the land is limited to those uses that would not diminish or degrade the wetland values. Acceptable uses are detailed in approved Wetlands Reserve Plans of Operations (WRPOs). WRPOs may allow hunting, fishing, timber harvest, haying, or grazing depending upon the situation. Cropping or other alterations that would harm the wetlands are not allowed.

The WRP easements or cost-share agreements would not necessarily prohibit an electric transmission line from crossing a wetland. The easement transfers most property rights to the NRCS, but does not specifically address utilities and road crossings. The NRCS may allow for utility crossings if the overriding national interest would benefit, but alternatively, it could indicate preference for another transmission route alternative. A biologist or the central NRCS office in Washington would likely decide if a proposed line or access road were a "compatible" use. Landowners can make "compatible use" requests throughout the life of the easement or agreement.